INSTRUCTION MANUAL

LEVELING AMPLIFIER

MODEL LA-3A

Manufactured in USA by

UNITED Recording Electronics INDUSTRIES
11922 Valerio Street
North Hollywood, California
91605

TELETRONIX MODEL LA-3A LEVELING AMPLIFIER

INTRODUCTION

The Teletronix Leveling Amplifier will automatically reduce audio peaks which might otherwise over drive broadcast or recording equipment.

Automatic gain reduction is accomplished by the use of an electro-optical variable attenuator, which is placed ahead of the first amplifier stage. The attenuation is controlled by the amplitude of the LA-3A input signal.

This system permits up to 40 dB of instantaneous gain reduction, yet causes no significant wave form or harmonic distortion. The amplifier provides sufficient gain and output level (+24 dBm nominal) to be used as a line or program amplifier, or for direct connection to the transmitter in the case of radio or TV operation.

Provisions are made for interconnection of two LA-3A Limiters to provide equal gain reduction in both channels.

SPECIFICATIONS

1.	Gain Reduction	:	Up to 40 dB
2.	Distortion	:	Less than 0.35% total harmonics at +24 dBm
3.	Response	:	$\pm$ 0.5 dB, 20 Hz to 20 kHz
4.	Noise	:	80 dB below program level at threshold of limiting

5.	Gain	:	30 ± 1 dB, or 50 ± 1 dB selected by switch on back of Limiter
6.	Output Level	:	+20 dBm nominal; +27 dBm max. peaks
7.	Input Level	:	0 dBm max. with 50 dBm gain setting +20 dBm max. with 30 dB gain setting
8.	Attack Time	:	1.5 ms or less depending on degree of limiting
9.	Release Time	:	Approximately 0.06 seconds for 50% release; 0.5 to 5 seconds for complete release depending upon amount of previous reduction
10.	Input Impedance	:	600 ohms floating
11.	Output Impedance	:	600 ohms floating
12.	Output Source Impedance	:	Approximately 50 ohms
13.	Panel Size	:	One-half rack
14.	Depth Behind Panel	:	9.25 inches
15.	Panel Controls	:	Gain (input level), Peak Reduction, Meter Selector Switch, and Power Switch
16.	Meter	:	dB Gain Reduction and dB Output read 0 VU at +4 dBm output
17.	Power Requirements	:	115/230 volts 50-60 cycle 35 watts
18.	Fuse	:	3AG, 1/8 AMP Slow Blow for 115V; 3AG 1/16 AMP Slow Blow for 230V

INSTALLATION

Line Voltage Switch

The LA-3a is set for a power line voltage of 115V when shipped. In order to change this for 230 volts, 50/60 Hz, slide the power source selector switch on the rear of the unit to the 230 volts position. A small screw driver should be used to operate this switch.

19" RACK MOUNTING (Single Unit)

The following parts are furnished in the SR-3A kit for mounting one LA-3A in a standard 19" USASI rack:

2	Rack Adapter Angles	UREI Part #25-11179
2	Rack Extensions	UREI Part #25-11176
4	6-32 Oval Head Screws (black)	
4	No. 6 Lock Washers	
4	6-32 Nuts	
4	8-32 Pan Head Screws	
4	No. 8 Lock Washers	

Installation Procedure

1. Mount angles to back side of rack extensions using black 6-32 screws, lock washers, and nuts. Do not tighten screws at this time.
2. Mount angle and rack extension assemblies to the tapped holes in the sides of the LA-3A, using 8-32 screws with lock washers. Do not tighten the screws at this time.
3. The LA-3A package is adjustable to allow optimum alignment of the front panel with the rack extensions. To effect precise alignment, loosen the front panel mounting screws and the top

and bottom cover mounting screws about 1/2 turn. Adjust relative positions of brackets and panels. Tighten all hardware.

19" RACK MOUNTING (Two Units)

The following parts are furnished in the DR-3A kit for mounting two LA-3A units side by side in a standard 19" USASI rack:

2	Joining Plates	UREI Part #25-11168
2	Rack Mounting Angles	UREI Part #25-11162
2	Spacer Plates	UREI Part #25-11163
4	8-32 Pan Head Screws	
4	No. 8 Lock Washers	

Installation Procedure

1. Place units side by side, with front panels touching. Remove proper screws in top of each unit to allow joining plate to be laid in place. Replace screws through plate and covers. Do not tighten screws completely at this time.
2. Turn assembly upside down and install other joining plate as in (1) above.
3. Mount one angle and one spacer plate to each side of the LA-3A, using the 8-32 screws and lock washers. The mounting holes in the LA-3A are tapped, and no nuts are required. The spacer plates should be located between the angles and the LA-3A chassis. Do not tighten the screws at this time.
4. The LA-3A package is adjustable to allow optimum alignment of the front panels and rack mounting angles. To effect precise alignment, loosen the front panel mounting screws and the top and bottom cover mounting screws about 1/2 turn. Adjust relative positions of brackets and panels. Tighten all hardware.

CIRCUIT DESCRIPTION

The LA-3A Leveling Amplifier will produce essentially instantaneous gain reduction of over 40 dB with no increase in harmonic distortion.

A typical gain reduction curve for this system is illustrated on Figure 1. Compressor action occurs from the breakaway point at -30 dB input and up to -20 dB, at which point the curve becomes horizontal to exhibit limiting action. The input increases an additional 20 dB, but the output increases less than 1 dB. The leveling amplifier thus combines the characteristics of a compressor and limiter. A reasonable amount of care in gain riding will restrict normal operation to the compression region, but uncontrolled output levels will be prevented by the limited action.

The heart of the leveling amplifier is the electro-optical attenuator which is placed ahead of the first amplifier stage. The actual stage gains and operating parameters are not varied, permitting the amplifier to operate at optimum conditions regardless of the amount of gain reduction.

The optical attenuator consists of photo-conductive cells, optically coupled to an electro-luminescent light source. The electro-luminescent device provides a light intensity which is proportional to the audio voltage applied to its terminals. Not unlike a capacitor in construction, the electro-luminescent lamp consists of a plate of glass or plastic coated with a clear conducting material on one side and a thin layer of phosphor on the other side. A metallic plate contacts the phosphor coating. As alternating current is applied to the conducting plates the phosphors are excited by the voltage across the

dielectric and light is produced. The amount of light depends upon the applied voltage and frequency. The gain or level controlling element is the photo-conductive cells. The resistance of the cells decreases with an increase in the impinging light. Since the light is produced directly from the audio voltage, the response is instantaneous. Rectification and filtering of the audio to produce a control signal are not necessary as in the case of conventional limiters. This system results in automatic level control whose speed of operation is limited only by the response of the variable resistance photo cells used.

Cells are selected which provide minimum attack time, and a release time which requires about 60 milliseconds for 50% release, and then a gradual release over a period of 1 to 15 seconds to the point of complete release.

Referring to Figure 2, the functional block diagram, the input signal is applied directly to the optical attenuator from the high impedance winding of the input transformer. The amount of attenuation introduced by the optical attenuator is controlled by the audio voltage applied to it by the lamp-driver amplifier. The amount of signal applied to the voltage amplifier is also controlled by the manual gain control. The voltage amplifier stage provides a gain of 26 dB. Overall amplifier feedback of approximately 80 dB provides low distortion, flat response, and gain stability.

For stereo applications, the gain reduction voltage amplifier of one unit may be coupled to another unit. The output of each voltage amplifier stage is applied to the stereo balance control and is also brought out to a terminal on the chassis. For stereo operation, this

terminal is connected to the same terminal on an identical amplifier and control voltage becomes common to both units. A gain-reduction control voltage generated in either amplifier will cause equal gain reduction in both units. The control voltage is applied through the stereo balance control to the lamp-driver amplifier. This stage provides the necessary voltage to operate the electro-luminescent light source.

OPERATION

The LA-3A Leveling Amplifier is designed to prevent an increase in output level beyond a pre-determined point, and due to its unique design, functions as a combined compressor and limiter. The effect is illustrated in Figure 1. The point at which the compressed curve breaks away from the straight "No-Gain Reduction" line is determined by the setting of the "Peak Reduction" control. It can be seen from the curve that compression occurs and gradually increases over the first 10 dB of input level rise. The slope of the curve then becomes horizontal, preventing an increase of output level regardless of input increase.

Control Settings

It is recommended that the "Peak Reduction" control be set to prevent increase in output level beyond the 100% modulation point. This setting should be made on typical program material.

Settings of the "Gain" and "Peak Reduction" controls are independent. However, the "Gain" control should be set to provide sufficient output after the "Peak Reduction" control has been adjusted.

The "Peak Reduction" control should be set for the desired amount of gain reduction as indicated by the meter. Continuous extreme reduction, such as 20 or 30 dB, does tend to reduce the dynamic range of music. Maximum benefit is obtained by running 4 to 8 dB of compression continuously.

For ease of control and to prevent overload of the input transformer, a switchable pad is included ahead of the LA-3A input transformer. In the high gain (50 dB) position the pad is switched out. When the device is to be used at input levels greater than 0 dBm the pad should be switched in by using the 30 dB position on the rear panel mounted gain switch.

VU Meter

The VU Meter serves two functions: it indicates output level as well as gain reduction directly in dB. When the meter selector switch is placed in the "output" position, the meter will indicate output level across the 600 ohm terminals. The meter is calibrated to read 0 VU or 100% when the amplifier output is +4 dBm.

The position marked "Gain Reduction" permits the meter to indicate the amount of gain reduction or peak limiting directly in dB. During periods of no gain reduction the pointer will return to 0 VU on the meter scale. The pointer is initially set to this position by means of the screw driver adjusted control located near the lower right hand corner of the meter.

Stereo

If two LA-3A Leveling Amplifiers are to be used in tandem for stereo, the gain reduction of each amplifier can be made equal, regardless of which channel is instigating the limiting. This is accomplished

by interconnecting terminals 3 and 4 of the LA-3A Leveling Amplifiers. The interconnecting wire should not be over two feet in length and should be shielded, the ends of the shield being connected to the #4 terminals (chassis).

Stereo "set-up" is as follows:

1. Connect the input terminals of the left and right channel LA-3A to an audio oscillator. Make certain that the amplifiers are connected in phase to the generator. A generator frequency of 400 to 1000 Hz is satisfactory. Generator output level should be set to the average level to be applied in operation.
2. Place the meter selector switch in the output position and adjust the LA-3A "Gain" controls for equal output. The "Peak Reduction" controls must be set to full counterclockwise or off.
3. Make certain that the stereo adjustment (R31) on the rear of each unit is fully clockwise. Place each meter selector switch in the "Gain Reduction" position.
4. Advance the "Gain Reduction" control on the left channel amplifier until approximately 5 dB of reduction is indicated on the meters. Note which channel is indicating the most gain reduction. Reduce the setting of R31 on this unit until both meters show equal reduction.
5. The "Gain Reduction" controls can now be placed at any desired setting, keeping both knob settings equal. Gain Reduction will now be equal on both channels.

GAIN REDUCTION FREQUENCY RESPONSE CONTROL

FM broadcasting and TV aural transmission systems use audio pre-emphasis in the transmitter. The standard is 17 dB increase in response at 15 kHz, the exact curve being the result of a 75 micro-second network. The program frequencies in the vicinity of 15 kHz will modulate the carrier 17 dB more than frequencies below 1 kHz. Thus, if the program material contains a large amount of high frequencies, over-modulation may occur if the levels had been previously adjusted for program material with less high frequency content.

An attempt to alleviate this problem has been made by others in the form of level controlled high frequency cutoff filters and high end peak clippers. Because the amount of control over the remainder of the spectrum is limited and because of the high distortion created, such devices have found only limited application.

The Teletronix Leveling Amplifiers are capable of at least 30 dB of gain reduction or limiting with less than 0.5% harmonic distortion. For most applications, such as AM broadcasting and recording, the amount of gain reduction is a function of input level and is independent of frequency.

By increasing the gain reduction at the higher frequencies, the over-modulation caused by the pre-emphasis can be greatly reduced or eliminated. While it is possible to increase the gain reduction sensitivity on an inverse of the pre-emphasis curve, this usually results in an insufficient leveling on the low frequencies. The actual amount of the limiter pre-emphasis must be determined according to the amount of high frequency content in the program material.

Adjustment of the gain reduction frequency response is accomplished by control R29 which is located on the rear of the LA-3A. Clockwise adjustment of R29 increases the gain of the voltage amplifier in the peak reduction circuit for frequencies above 1 kHz. The low frequency components are not affected because of the high reactance of C7. If the control is set to the "flat" position the LA-3A will provide equal reduction at all frequencies. If the control is moved away from the "flat" position, the leveling will be greater on the high frequencies. The actual setting can best be determined on program material for a compromise between low and high frequency limiting. Maximum clockwise rotation will provide approximately 10 dB more reduction at 15 kHz than at frequencies below 1 kHz.

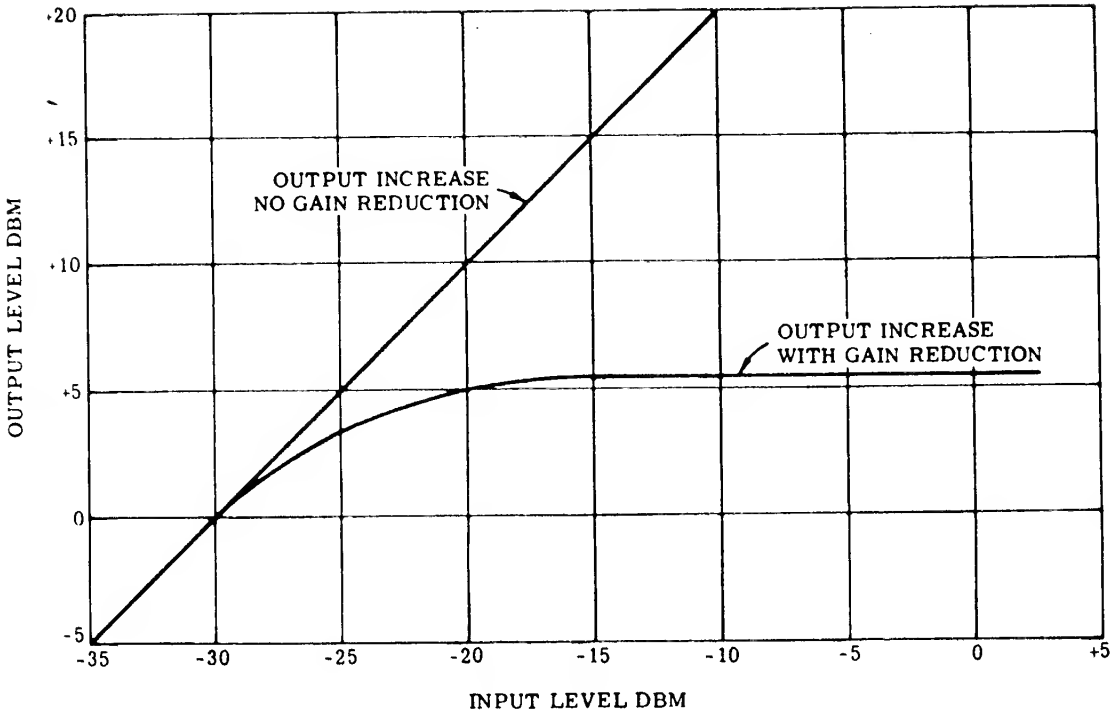


FIGURE 1. TYPICAL GAIN REDUCTION PLOT FOR LA-3A

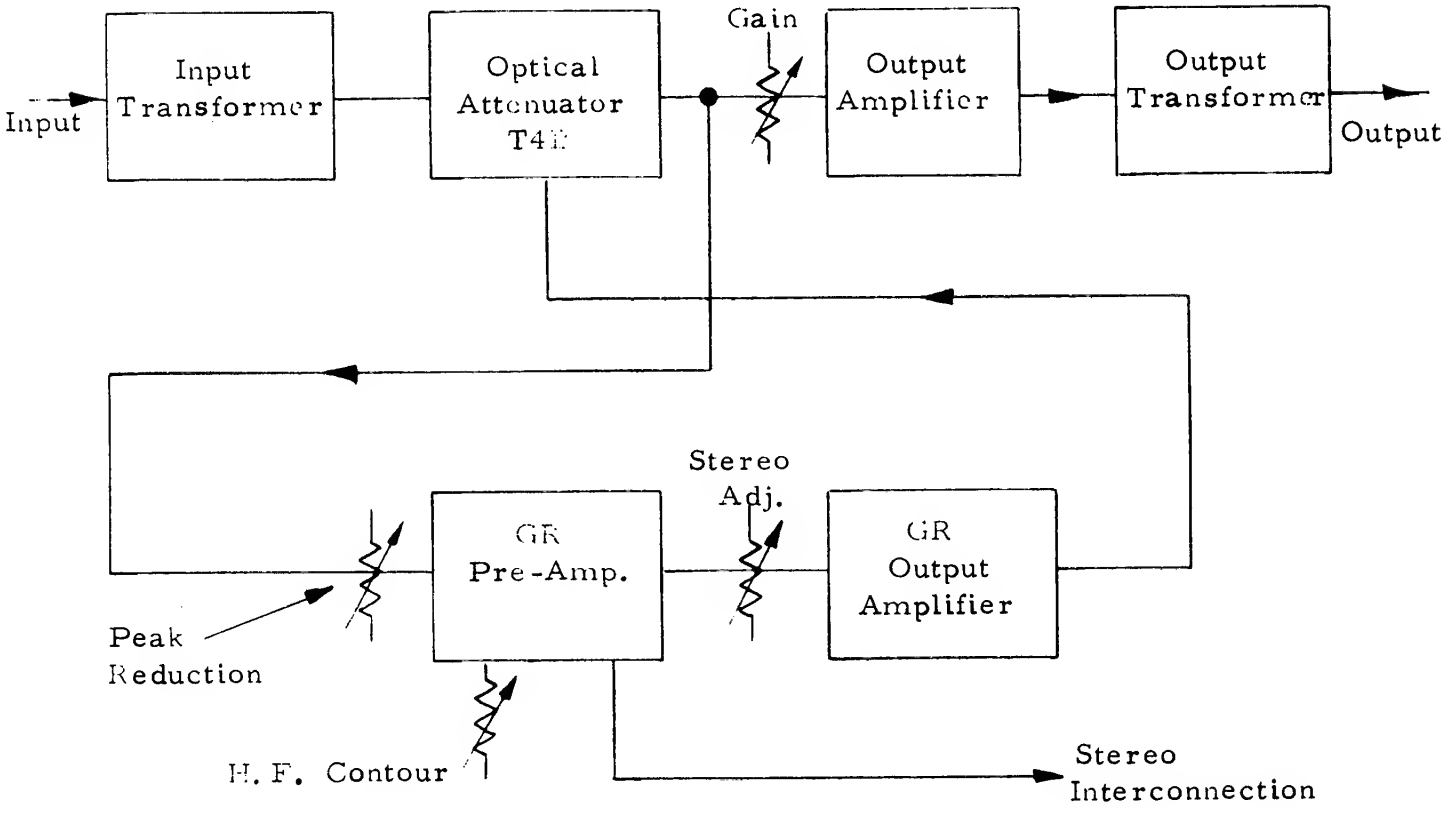
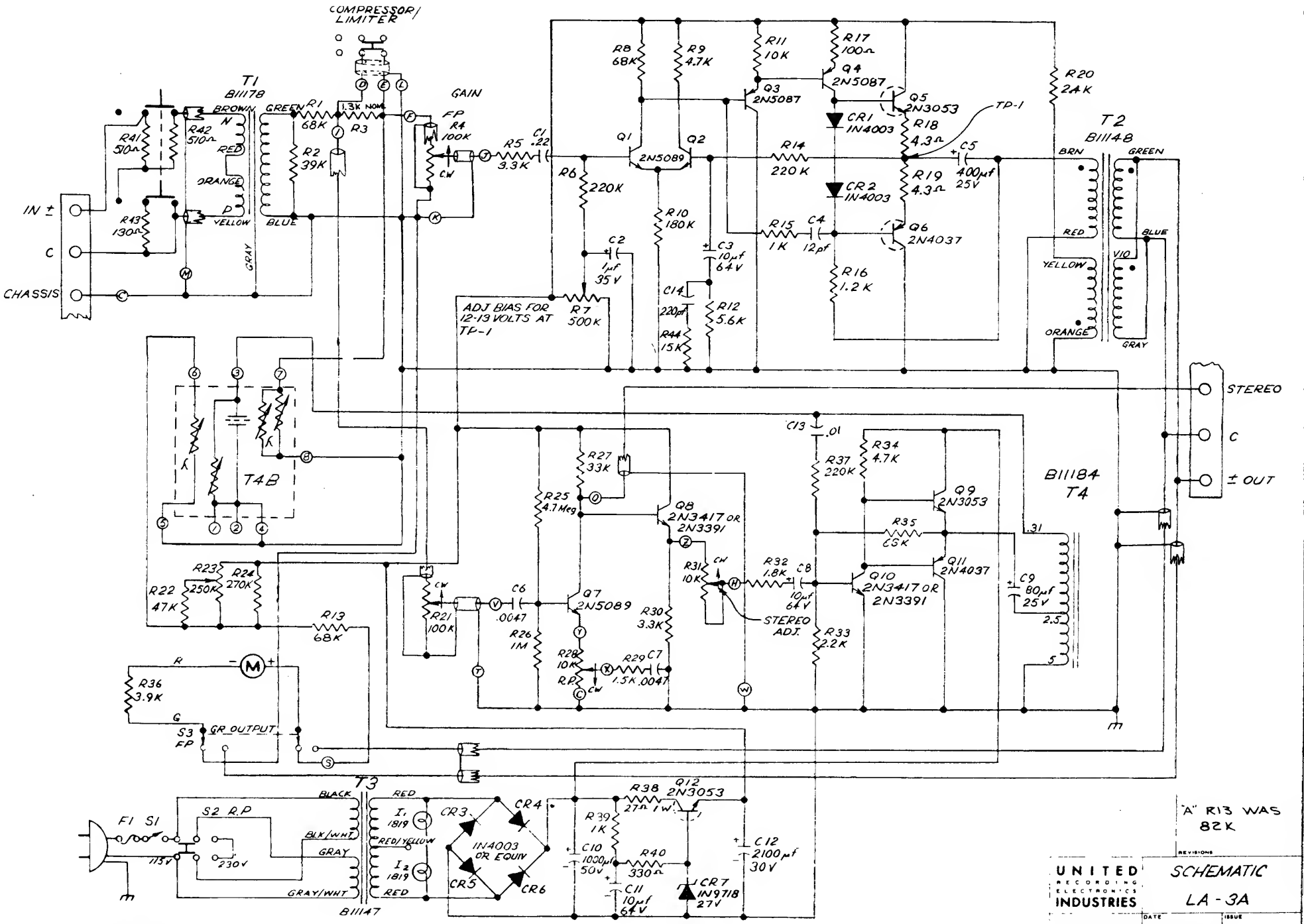


FIGURE 2. LIMITER BLOCK DIAGRAM



FUSE:
3AG ~~8~~ AMP SLO-BLO FOR 120V
3AG ~~1/8~~ AMP SLO-BLO FOR 220V

STEREO SET-UP FOR LA-3

1. CONNECT THE INPUT TERMINALS OF THE LEFT AND RIGHT CHANNELS OF THE LA-3 TO AN AUDIO OSCILLATOR. MAKE CERTAIN THAT THE AMPLIFIERS ARE CONNECTED IN PHASE TO THE GENERATOR FREQUENCY OF 400 TO 1000 HZ IS SATISFACTORY. GENERATOR OUTPUT LEVEL SHOULD BE SET TO THE AVERAGE LEVEL TO BE APPLIED IN OPERATION.

2. PLACE THE METER SELECTOR SWITCH IN THE OUTPUT POSITION AND ADJUST THE LA-3 "GAIN" CONTROLS FOR EQUAL OUTPUT. THE "PEAK REDUCTION" CONTROLS MUST BE SET TO FULL COUNTERCLOCKWISE OR OFF.

3. MAKE CERTAIN THAT THE STEREO ADJUSTMENT (R31) ON THE REAR OF EACH UNIT IS IN THE"GAIN" REDUCTION POSITION .

4. ADVANCE THE "GAIN REDUCTION" CONTROL ON THE LEFT CHANNEL AMPLIFIER UNTIL APPROXIMATELY 5 DB OF REDUCTION IS INDICATED ON THE METERS. NOTE WHICH CHANNEL IS INDICATING THE MOST GAIN REDUCTION. REDUCE THE SETTING OF R31 ON THIS UNIT UNTIL BOTH METERS SHOW EQUAL REDUCTION.

5. THE "GAIN REDUCTION" CONTROLS CAN NOW BE PLACED AT ANY DESIRED SETTING, KEEPING BOTH KNOB SETTINGS EQUAL. GAIN REDUCTION WILL NOW BE EQUAL ON BOTH CHANNELS.

TEST PROCEDURE FOR LA-3

SETUP POSITIONS:

NO IN PUT LOAD
GAIN 30DB ----REAR PANEL
COMPRESS/LIMIT SWITCH IN LIMIT POSITION
HF CONTOUR CW
STEREO ADJ. CW

+2DB INPUT
GR/OUTPUT SW TO OUTPUT POSITION
PK REDUCTION CCW

SET VU METER TO ZERO VU WITH GAIN LEVEL CONTROL

TEST

GR/OUTPUT SWITCH BACK TO GR
PK REDUCTION FULL CW SHOULD BE -6DB TO -10DB
ON VU AS WELL AS EXTERNAL METER.

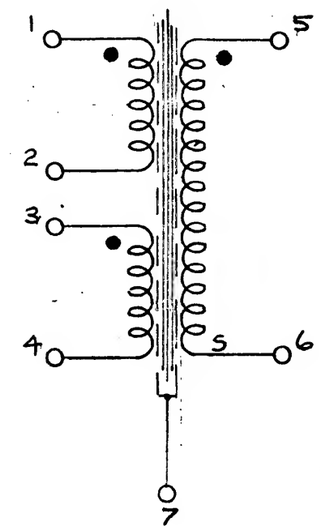
ELECTRICAL:

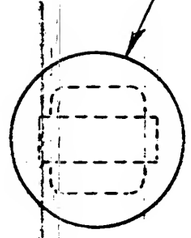
1.	Frequency Response; With 150K secondary load	± .5 dB 30 - 15,000 Hz ± 1 dB 20 - 20,000 Hz
2.	Harmonic Distortion;	.5% @ Any frequency between 20 Hz and 20,000Hz @ 0 dBm input level .25% @ Any frequency between 30 Hz and 15,000 Hz @ 0 dBm input level strapped for 600 ohm source with 150K resistive load across secondary.
3.	Magnetic Shielding;	40 dB or better @ 60 Hz.
4.	Freq. Resp. Curve;	Must fall smoothly with no peaks or dips which fall outside of a 6 dB envelope constructed about the median response curve, with 150K secondary load
5.	Phase Shift;	90° max. @ 40,000 Hz and 45° max. from 20 Hz. to 20,000 Hz. with 150K secondary load.
6.	Primary Impedance;	150 ohms across pins 1 and 2 and 150 ohms across pins 4 and 3 with 15K resistive load across secondary.

MECHANICAL:

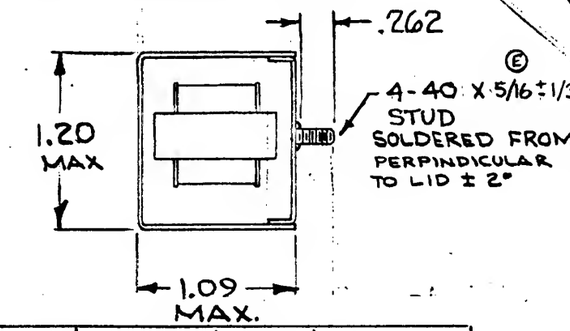
1. Transformer to be oriented in can as shown
2. BRIGHT TIN PLATE CAN & LID, mark as shown with permanent and legible black ink.
3. Screw threads and wire leads to be free of paint.
4. Leads must be capable of withstanding reasonable twisting and pulling consistent with good transformer fabrication practice.
5. Transformer windings shall not be filled with varnish or any potting material which will adversly affect high frequency response.
6. MTG. STUDS SHALL BE ELECTRICALLY CONDUCTIVE FROM ONE TO THE OTHER. (SOLDERED TO LID)

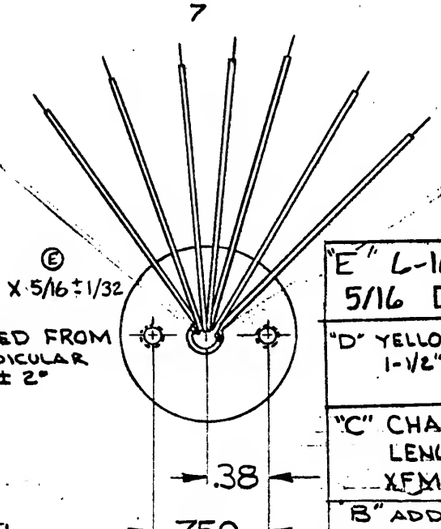
SCHEMATIC





MARK UREI PART NO. B11178 INCLUDE DATE AND SOURCE CODE





LEAD #	COLOR	LENGTH	STRIP + TIN
1	BROWN	1-1/2	1/4"
2	RED	1-1/2	1/4"
3	ORANGE	1-1/2	1/4"
4	YELLOW	1-5/8	1/4"
5	GREEN	1-1/2	1/4"
6	BLUE	1-1/2	1/4"
7	GRY	1-1/2	1/4"

REVISIONS

A CHG'D DIMENSIONS

B" ADDED NOTE 6. FINISH WAS PAINT

"C" CHANGED SCREW LENGTH, DIA OF XFMR WAS 1.25

"D" YELLOW WIRE WAS 1-1/2" LONG 10-4-71 JE

"E" L-16-76 BDM 5/16 DIM. WAS 1/4

UNITED RECORDING ELECTRONICS INDUSTRIES	TRANSFORMER INPUT	
DEPARTMENT	DATE 4-3-70	ISSUE MODEL
LOS ANGELES CALIFORNIA	CHECKED JE	APPROVED DWG. NO. B11178B